



**NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF AVIATION SAFETY
WASHINGTON, D.C. 20594**

November 22, 2013

Group Chairman's Factual Report

MAINTENANCE

- A. ACCIDENT:** DCA13MA120
- LOCATION: San Francisco, California
- DATE/TIME: July 6, 2013, about 1128 PDT
- AIRCRAFT: Asiana Airlines Boeing 777-200ER, HL7742,
S/N 29171, Line 553
- B. GROUP MEMBERS:**
- Group Chairman: Pocholo Cruz
National Transportation Safety Board
Washington, DC
- Member: Jung-Ho (John) Kim
ARAIB
Seoul, South Korea
- Member: Robert Smedley
Federal Aviation Administration
Daly City, California
- Member: Richard Anderson
The Boeing Company
Seattle, Washington

Member: Hyung Jun Choi
Asiana Airlines
Seoul, South Korea

Member: Jong Won (Jason) Kim
Asiana Airlines
Seoul, South Korea

C: SUMMARY

On July 6, 2013 at 11:28 am Pacific daylight time, a Boeing 777, registration HL7742, operated by Asiana Airlines as flight 214, struck the seawall short of runway 28L at San Francisco International Airport. The airplane was destroyed by impact forces and fire. Three of the 291 passengers were fatally injured. The flight was a regularly scheduled passenger flight from Incheon International Airport, Seoul, Korea, and was operated under the provisions of *14 Code of Federal Regulations Part 129*. Visual meteorological conditions prevailed at the time of the accident.

D: DETAILS OF THE INVESTIGATION

1.0 Air Carrier Certificates

On November 10, 2001, The Republic of Korea Ministry of Land Infrastructure and Transport (MOLIT) issued Air Operator Certificate 2001-A02 to Asiana Airlines Inc. (47, Osae-Dong, Gangseo-gu, Seoul, Korea). The certificate certifies that Asiana Airlines, Inc. was authorized to perform commercial air operations (International and Domestic) as defined in the operations specification in accordance with the Operation Manual and the Civil Aviation Act of the Republic of Korea and regulations and standards.

See Attachment 1 for further information

2.0 Operations Specifications (OpSpecs)¹

The Aviation Safety Division of MOLIT issues the Asiana Airlines Inc. Operation Specifications. The Korean OpSpecs includes the standards, terms, conditions, and limitations contained in the Operations Specifications (Parts D and E). The FAA unilaterally approves the Korean OpSpecs.

- (a) Air carrier was authorized for scheduled air operations.
- (b) Per section D072 of the OpSpecs, the Continuous Airworthiness Maintenance Program (CAMP), authorized Asiana Airlines, Inc. to use the B777-200 Maintenance Program Document Number A934, Rev 10 dated January 10, 2013 to maintain the airplanes.
- (c) Per section D074 of the OpSpecs, Asiana Airlines, Inc. was authorized to apply reliability program procedures per the Maintenance Policies and Procedures Manual 7.6 Reliability Control Program (Rev 133, dated January 4, 2012)

¹ Operations Specifications contains the authorizations, limitations, and certain procedures under which each kind of operation, if applicable, is to be conducted by the certificate holder.

- (d) Per section D076 of the OpSpecs, Asiana Airlines, Inc. was authorized to use short-term escalations of maintenance intervals on their fleet.
- (e) Per section D081 of the OpSpecs, Asiana Airlines, Inc. was authorized to participate in Parts Pool Agreements with other airlines.
- (f) Per section D083 of the OpSpecs, Asiana Airlines has a Parts Borrowing authority. The parts shall be borrowed from scheduled air transport servicing airlines applying Continuous Airworthiness Maintenance Program, or airlines applying equal maintenance programs.
- (g) Per section D084 of the OpSpecs, Asiana Airlines, Inc. was authorized to conduct Ferry Flights with Authorizations for Special Flight permit.
- (h) Per section D085 of the OpSpecs, Asiana Airlines, Inc. has 10 A320, 24 A321, 13 A330, 8 767 (7 Passenger / 1 Cargo), 12 777 and 14 747 (4 Passenger / 10 Cargo) aircraft in its fleet.
- (i) Per section D086 of the OpSpecs, Asiana Airlines, Inc. was authorized to conduct two-engine airplanes used in extended-range operations. B777 maximum diversion was limited to 207 minutes.
- (j) Per section D091 of the OpSpecs, Asiana Airlines, Inc. was authorized to make arrangements with other organizations to perform substantial maintenance. A listing of the organizations was listed in the OpSpecs.
- (k) Per section D092 of the OpSpecs, Asiana Airlines, Inc. may operate aircrafts in designated Reduced Vertical Separation Minimum (RVSM) airspace by using the aircraft equipped altitude maintaining system.
- (l) Per section D095 of the OpSpecs, Asiana Airlines, Inc. was authorized to use a Minimum Equipment List (MEL) with the following limitations.
 - a. Items of Category A must be corrected within the correction time specified in the authorized MEL of The Air Operator Certificate Holder.
 - b. Items of Category B must be corrected within continuous 3 Calendar days (72 hours), except that day when the malfunction was recorded in the on-board flight log.
 - c. Items of Category C must be corrected within continuous 10 Calendar days (240 hours), except that day when the malfunction was recorded in the on-board flight log.

- d. Items of Category D must be corrected within continuous 120 Calendar days (2,880 hours), except that day when the malfunction was recorded in the on-board flight log.
- (m) Per section D485 of the OpSpecs, Asiana Airlines, Inc. had an Aging Aircraft Inspection and Records Review. The accident airplane was below the threshold for the record reporting.
- (n) Per section E096 of the OpSpecs, Asiana Airlines, Inc. was authorized for a Weight and Balance Program (OOB096, Rev 15, dated March 11, 2013).

3.0 Aircraft Information

The Boeing Airplane Company manufactured the accident airplane on 6 February 2006 (factory complete date). The airplane was delivered to Asiana Airlines, Inc. on 7 March 2006. The airplane had accumulated approximately 37,120 total hours with 5,388 total cycles at the time of the accident. The airplane was equipped with two Pratt and Whitney Turbofan 4090 engines and a Honeywell APU.

Table 1 – Engine and APU Information

	No.1 Engine	No.2 Engine	APU
Manufacturer	Pratt and Whitney	Pratt and Whitney	Honeywell
Part Number	PW4090	PW4090	GTCP 331-500 (B)
Manufacture Date	30/Dec/2005	14/Mar/2002	26/May/2005
Date Installed	1/Jun/2013	15/Jul/2009	26/Jan/2011
Serial Number	P222240	P222186	P-1615
Location of Engine/APU Installation	ICN	ICN	ICN
Total Time (Engine /APU hours) at installation	30,829	27,928	8,129
Total cycles (Engine/APU cycles) at installation	4,423	4,455	6,151
Total Time (hours) of Airframe during engine/APU installation	36,667	17,031	24,888
Total cycles of Airframe during engine/APU installation	5,325	2,716	3,731
Time Since Overhaul (hours)	444	20,080	3,795
Hours and (cycles) since last installation	444 (62)	20,080 (2,671)	3,795 (3,449)
Total Time in hours and (cycles) as of July 6, 2013	31,273 (4,485)	48,008 (7,126)	11,924 (9,600)

Note: APU Total Time and Cycles were updated on 4 July 2013

4.0 Maintenance and Inspection Programs

The Asiana Airlines (AAR) 777-200 Maintenance Program provides scheduled maintenance program information. The Asiana Airlines 777-200 Maintenance Program includes the recommended scheduled maintenance requirements for the 777-200 models arising from:

- Maintenance Review Board Report (MRBR)²
- Boeing Maintenance Planning Data document (MPD)³
- Airworthiness Directives (AD)⁴ requirements
- Certification Maintenance Requirements (CMRs)⁵
- Airworthiness Limitations (AL)⁶
- Service Bulletins (SB)⁷, Service Letter (SL)⁸, Vendor Manual, Boeing Telex
- Additional maintenance tasks considered for Asiana Airlines experiences, economical effectiveness and reliability improvement.

Requirements of the Maintenance Program are developed under the process guidelines of the ATA Airlines/Manufacturer Maintenance Program Development Document, Maintenance Steering Group 3 (MSG-3)⁹. Maintenance Program reflects maintenance tasks as listed in the latest Boeing 777 D622W001 MPD. Adjustments to Maintenance Program must be approved by (MOLIT) annually.

The Maintenance Program is revised annually to reflect:

- Change of the Boeing 777-200 MRBR / MPD
- In service experience
- Repetitive maintenance tasks arising from Airworthiness Directives (AD), Service Bulletins (SB), & Service Letter (SL)

Asiana also uses the Maintenance Policy and Procedures Manual (MPPM) which outlines the policies and procedures used to carry out the maintenance program. Portions of the MPPM are approved by MOLIT.

² An MRBR is the guidance document that is comprised of the principles that should be applied to the development of an operator's maintenance program.

³ MPD is the manufacturer's data developed concerning a particular airplane that contains the information each operator of that airplane needs to develop a customized scheduled maintenance and inspection program.

⁴ An AD is issued by FAA when an unsafe condition is identified with an aircraft, aircraft engine, propeller, or appliance (products). The AD specifies the action required to address the safety issue and maintain the type design of the product.

⁵ A CMR is a required periodic task, established during the design certification of the airplane as an operating limitation of the type certificate. CMRs usually result from a formal, numerical analysis conducted to show compliance with catastrophic and hazardous failure conditions. CMRs intended to detect safety-significant latent (hidden) failures that would, in combination with one or more specific failures or events, result in a hazardous or catastrophic failure condition.

⁶ Airworthiness Limitations section of a manufacturer's maintenance manual or Instructions for Continued Airworthiness, represent those items of inspection or maintenance an operator must perform in accordance with that section of its manual, or in accordance with operations specifications approved by the Approval authority.

⁷ A document issued by the manufacturer to notify the operator of an aircraft (or engine or other device) of recommended (or required by Airworthiness Directives) modifications, substitute parts, special inspections/checks, reduction of existing life limits or establishment of first-time life limits and conversions from one engine model to another. Service Bulletins may or may not be FAA-approved.

⁸ Changes to the manufacturer's recommended continuing maintenance program are usually contained in documents such as Service Letters. They may or may not be approved by the Approval Authority. SLs represent manufacturer's amendments to its continuing maintenance program for a given product.

⁹ MSG-3 is a voluntary structured process developed by the industry and maintained by ATA (A4A) to make decisions that are used to develop scheduled maintenance and inspection tasks and intervals for aircraft that will be acceptable to the regulatory authorities, the operators, and the manufacturers.

(a) Maintenance Check and Intervals

Line Maintenance: The line maintenance checks consist of Transit Check and Line Service Check. The purpose of Transit and Line Service Check is intended to assure continuous serviceability of in-service and transiting aircraft.

- a. The Transit Check: This check is planned for use at an en-route stop and is basically a "walk-around" inspection which requires a check of the aircraft interior and exterior for obvious damage, leaks, proper operating equipment, security of attachment and required servicing.
- b. The Line Service Check: This check may package any or all of the tasks with interval 48 elapsed hours and Asiana Airlines' in-service tasks and include all Transit Check Tasks.

Base Maintenance (Scheduled Maintenance): The Scheduled Maintenance has the specified interval. Intervals are expressed in flight hours, cycles, calendar time, or characteristics. Scheduled Maintenance includes the correction of the abnormal condition accumulated during the Line Maintenance. The Scheduled Maintenance consists of GA, GB, GC, GD checks.

Asiana Airlines' maintenance program for the accomplishment of scheduled maintenance tasks follows the manufacturer's B777 Maintenance Planning Data document. The methodology employed is comprised of "grouping" of tasks. The "Groups" of tasks are so packaged as to meet compliance requirements, and maximize aircraft availability for dispatch. This is defined as follows:

a. Group A (GA) Check Interval:

According to Asiana's Maintenance Program Document No. A934 (revision 10 dated 10 January 2013), The Group "GA" check intervals are conducted at intervals not to exceed 500 flight hours and consists of 6 checks (1GA, 2GA, 3GA, 4GA, 6GA, and 12GA). However, according to Asiana maintenance personnel, the "GA" Check actually consists of 12 repetitive phases (1GA to 12GA) and are accomplished at an interval not to exceed 500 flight hours. As such, one complete "GA" Check sequence was then accomplished every 6000 flight hours.

For example: (GA sequence = 1GA....12GA, 1GA....12GA)

b. Group B (GB) Check Interval:

According to Asiana's Maintenance Program Document No. A934 (revision 10 dated 10 January 2013), The "GB" Check is to be accomplished at interval not to exceed 7,500 Flight Hours and consisted of 1GB, 2GB. According to Asiana maintenance personnel, The "GB" check includes the accomplishment of a "GB tasks" and "GA phase check coming due". The Check is documented in maintenance program records as 1GB, 2GB, 3GB, etc.

For example: (1GB = GB tasks + GA phase check coming due, 2GB = GB tasks + GA phase check coming due, etc.)

c. Group C (GC) Check Interval:

According to Asiana's Maintenance Program Document No. A934 (revision 10 dated 10 January 2013), The "GC" Check is to be accomplished at intervals not to exceed 1,125 days and consists of 1GC, 2GC. According to Asiana maintenance personnel, the "GC" check includes the accomplishment of "GC tasks", "GB tasks coming due" and "GA phase check coming due". The Check is documented in maintenance program records as 1GC, 2GC, 3GC, etc.

For example: (1GC = GC Tasks + GB Tasks coming due + GA phase check coming due, 2GC = GC Tasks + GB Tasks coming due + GA phase check coming due, etc.)

d. Group D (GD) Check Interval: 3,000 calendar days.

According to Asiana's Maintenance Program Document No. A934 (revision 10 dated 10 January 2013), the "GD" Check is to be accomplished at intervals not to exceed 3,000 days and consists of 1GD. According to Asiana maintenance personnel, the "GD" check includes the accomplishment of "GD" tasks, "GC tasks coming due", "GB tasks coming due" and "GA phase check coming due". The Check is documented in maintenance program records as 1GD, 2GD, 3GD, etc.

For Example: (1GD = GD tasks +GC task coming due + GB tasks coming due + GA phase check coming due, 2GD = GD tasks + tasks +GC task coming due + GB tasks coming due + GA phase check coming due, etc.)

e. CCL, CL and LCL Check Interval: The component calendar check (CCL), calendar check (CL) and limited calendar check (LCL) are

repetitive individual maintenance requirement not categorized in the package type. It is performed per its own interval.

(b) Auxiliary Power Unit / Engine Maintenance Program

APU/Engine Life-limited Parts and Off-aircraft tasks are controlled by MPPM "APU/ENG Maintenance Program". The Asiana Airlines Inc. programs are derived from the APU and Engine Manufacturers Maintenance Program.

(c) Structural Maintenance Program

This program is designed to provide timely detection and repair of structural damage which may occur in the fleet during commercial operations. Detection of corrosion, stress corrosion, minor accidental damage and fatigue cracking by visual and/or Non-Destructive Test (NDT) procedures is considered. Within this program, the Corrosion Prevention and Control Program (CPCP) and the Fatigue Related Inspection Program are accomplished.

(d) Zonal Inspection Program

The Zonal Inspection Program includes a general visual and, if required, physical checks of the general condition and security of attachment of the accessible systems and structures items contained in defined zones. This includes checks for degradation such as chafing of tubing, loose duct supports, damage to Electrical Wiring Interconnection System (EWIS) , cable and pulley wear, fluid leaks, electrical bonding, general condition of fasteners, cracked, chipped, or missing paint on composite structure, inadequate drainage, etc., and general corrosion, not covered in the MSG-3 analysis. The zonal inspection is not intended as a quality assurance after maintenance check for determining proper reassembly of systems, components, structures, or powerplants.

The Zonal program packages a number of General Visual (GV) Inspections into one or more zonal inspections. The program includes any General Visual Inspection tasks required to assure security of attachment and general condition of any system or structural items within the zone.

(e) Component Maintenance Program

The Component Maintenance Program serves the management of time regulated parts. "Time Regulated Part" means items that are designed to have unique life time limit and to be replaced, discarded, and restored within the regulated time.

Maintenance of Time Regulated Parts is designated by calendar time whereas any part controlled by flight hour or cycle is managed in the system maintenance program. Components with issues due to removal/installation and/or location change which are normally designated under the system maintenance program, could be selected as time limitation parts. The maintenance method and application standard was controlled by Maintenance Policies & Procedures Manual. The component calendar check (CCL), calendar check (CL) and limited calendar check (LCL) are repetitive individual maintenance requirements not categorized in the package type. These are performed per their own specified interval.

The following is a listing of the previous inspections accomplished on the accident airplane. This information was retrieved from the airplane maintenance records:

Table 2 – Maintenance Checks

Check	Last Check Date	Location*	Total Time	Total Cycles
Transit Check	6/Jul/2013	ICN	37,111	5,387
Line Service Check	6/Jul/2013	ICN	37,108	5,385
9 GA	28/Jun/2013	ICN	36,992	5,371
8 GA	23/May/2013	ICN	36,561	5,301
7 GA	19/Apr/2013	ICN	36,089	5,231
6 GA	19/Mar/2013	ICN	35,653	5,171
5 GA	14/Feb/2013	ICN	35,174	5,101
4 GA	15/Jan/2013	ICN	34,778	5,043
3 GA	11/Dec/2012	ICN	34,294	4,971
2 GA	29/Oct/2012	ICN	33,798	4,905
1 GA	27/Sep/2012	ICN	33,379	4,842
12 GA	31/Aug/2012	ICN	32,958	4,789
11 GA	31/Jul/2012	ICN	32,539	4,724
10 GA	27/Jun/2012	ICN	32,054	5,385
2 GB	11/Dec/2012	ICN	34,293	4,971
1 GB	23/May/2011	ICN	26,363	3,927
GC**				
2 GC	23/May/2011	ICN	26,363	3,927
Group D	N/A***			

*ICN - Incheon International Airport

**Following the B777 Maintenance Planning Data document (MPD), Asiana Airlines records indicate all required task card items as recommended were accomplished within the 1,125 calendar day requirement.

***Accident airplane had not reached this threshold at the time of the accident.

See Attachment 2 for further information

5.0 Minimum Equipment List (MEL)¹⁰

Asiana Airlines, Inc. is authorized to use an approved MEL on its airplanes per its OpSpecs. At the time of the accident, there were no open MEL items and one

¹⁰ The FAA approved Minimum Equipment List contains a list of equipment and instruments that may be inoperative on a specific aircraft for continuing flight beyond a terminal point.

Configuration Deviation List¹¹ (CDL) item listed in the airplane logbook. The CDL 57-53-1 is for a L/H wing lower flaperon inboard seal missing.

See Attachment 3 for further information

6.0 Supplemental Type Certificates (STC)¹²

Supplemental Type Certificates (STCs), supplied by air carrier, were reviewed. A total of two STCs were documented and installed by the operator.

Table 3 – Supplemental Type Certificates

STC No:	Modification Description	Date Accomplished
ST02656NY-D	Delta Engineering – Update to Panasonic 3000i Entertainment System	23/May/2011
ST01889SE-D	JAMCO America B777 Interior reconfiguration	23/May/2011

See Attachment 4 for further information

7.0 Airworthiness Directive (AD)¹³ and Service Bulletin (SB) Summary

Airworthiness Directive:

Asiana Airlines Airworthiness Directive compliance system is described in the Asiana Airlines Maintenance Policy and Procedures Manual (MPPM) Section 8.5. A review of FAA data reflects a total of 36 applicable Airframe AD's for this aircraft. The compliance record review of the effective Airworthiness Directives for the accident airplane was conducted in comparison with published FAA AD's for B-777-200ER aircraft. Asiana's AD compliance recording format presents a detailed record of status. No anomalies were observed. Particular focus was placed on reviewing compliance records for effective AD's for ATA Chapters 22 (Autoflight Systems), 23 (Communications), 27 (Flight Controls), 34 (Navigation) and 55 (Stabilizers). The compliance records reviewed revealed the AD status of the aircraft to be current. No regulatory non-compliance concerns were observed. See Table 4 below.

There are no powerplant ADs applicable to the engines installed on the airplane. Further, there are no appliance ADs applicable to the accident airplane.

¹¹ A configuration deviation list (CDL) is a list, established by the organization responsible for the type design with the approval of the State of Design, which identifies any external parts of an aircraft type which may be missing at the commencement of a flight, and which contains, where necessary, any information on associated operating limitations and performance correction. (ICAO Annex 6: Operation of Aircraft)

¹² The FAA issues Supplement Type Certificates, which authorize a major change or alteration to an aircraft, engine or component that has been built under an approved Type Certificate.

¹³ Airworthiness Directive (AD) is a regulatory notice sent out by the FAA informing the operator of an action that must be taken for the aircraft to maintain its airworthiness status.

Table 4 – Airworthiness Directives

Airworthiness Directive Number	Description	Date Accomplished	Effective Date
2007-13-05	Action to prevent rudder & elevator control surface flutter	7/Mar/2013	25/Jul/2007
2007-17-12	HS Ballscrew drive mechanism failure prevention	14/May/2013 See 2009-14-06	2/Oct/2007
2007-26-05	Elevator actuator attach fitting inspection	Open. See 2013-08-02	22/Jan/2008
2009-14-06	HS ballscrew failure prevention	14/May/2013	12/Aug/2009
2010-06-09	Inadvertent engagement of A/P	13/Jun/2012	1/Apr/2010
2011-05-12	Detect & correct HSTA fitting installation	Initial Inspection Open	14/Apr/2011
2012-10-10	Insp. Horizontal Stabilizer pivot pin	Initial Inspection Open	29/Jun/2012
2013-05-10	Detect & correct corrosion in slide operating mechanism	Open. Partially Complied With	03/May/2013
2013-08-02	Inspection for cracks elevator actuator fitting	Initial Inspection Open	24/May/2013

Service Bulletins:

According to Boeing records, a total of 156 service bulletins encompassing all airframe ATA chapters and a further 3 bulletins for the power plants have been released which are applicable to the accident airplane. A review of Asiana's records show that 133 of these bulletins either have or were in the process of being completed at the time of the accident. Seven of the 28 Alert Service Bulletins remained in the 'open' status; these are mainly due to periodic inspections which are due at a later date or that terminating action had not taken place.

Boeing classifies all service bulletins in one of three categories: Standard (STD; 98 are applicable to the accident airplane), Unusually Significant (USG; 33 are applicable to the accident airplane), and Alert (ALT; 28 are applicable to the accident airplane). Standard bulletins consist of product improvement offerings and updates to the as-delivered configuration. USG bulletins are marked as 'SPECIAL ATTENTION' and are so classified as significant changes to the as-delivered configuration and a higher risk of economic consequences for non-incorporation of the bulletin. Alert bulletins are reserved for bulletins which carry risk to the safety of the airplane and/or the occupants. Asiana Maintenance Engineering receives notification from Boeing via email that new bulletins are available for review via My Boeing Fleet, a web-based subscription service which provides updated information pertaining to an operators' fleet. Asiana's Maintenance Engineering then evaluates service bulletin incorporation based on priority with potential Airworthiness Directive the highest, Alert Bulletins the second highest, and others based on an internal economic risk and reliability analysis.

See Attachment 5 for further information

8.0 Airplane System Review

Autoflight system

According to Boeing records, the following autoflight service bulletins were effective for the accident airplane:

Table 5 – ATA Chapter 22 Bulletins

Bulletin	Description	Completion
777-22-0017, Rev 00	Autopilot Flight Director Software Change	30/Aug/2007
777-22A0024, Rev 00	Install Autopilot Flight director Computer Operational Program Software	15/Feb/2010

Furnishing/Equipment

Boeing records show the following effective service bulletins for the accident airplane:

Table 6 – ATA Chapter 25 Bulletins

Bulletin	Description	Completion
777-25-0400, Rev 00	Disposable Oxygen Mask Replacement	No Data*
777-25-0218, Rev 03	Cargo Compartment – Neoprene-Coated Liner – Rub Plate Installation	No Data*
777-25-0427, Rev 00	Passenger Compartment Lining – Door 1 Left Side and Door 1 Right Side Safety Strap Bracket Assembly change	02/Dec/2012
777-25-0507, Rev 00	Emergency - Door-Mounted Escape Slide Pack - Change to Escape Slide/Raft to Prevent Corrosion of Packboard Release Mechanism (FAA AD 2013-05-10)	See Note

*Asiana records indicate that these bulletins have not been installed. The two bulletins noted are classified as ‘Standard’ Bulletins; their installation was optional by the operator.

Note: According to Asiana’s records, this service bulletin had been partially complete per the following information:

Table 7 – 777-25-0507 Completion Information

Door Slide Location	Completion Date
L1	Open; to be accomplished by 30/Jun/2014
L2	22/Mar/2012
L3	20/May/2011
L4	29/Jul/2011
R1	17/Jun/2011
R2	24/Feb/2012
R3	23/Jun/2011
R4	Open; to be accomplished by 30/Jun/2014

Navigation

Boeing records show the following navigation service bulletins were effective for the accident airplane:

Table 8 – ATA Chapter 34 Bulletins

Bulletin	Description	Completion
777-34A0191, Rev 01	Radio Altimeter Transceiver Replacement	Open To be accomplished by 20/Sep/2013
777-34A0192, Rev 00	Low Range Altimeter Antenna Replacement	Open To be accomplished by 31/Dec/2014

9.0 Aircraft Flight Logs

All of the daily flight logs for the accident airplane from 1 January 2013 to the date of the accident were examined. There were no major discrepancies noted to have occurred during this time; most of the maintenance entries were scheduled MPD maintenance tasks. There was no indication that the airplane incurred any significant maintenance delays prior to a scheduled flight.

The flight logs for the accident airplane were examined in detail for the previous 10 calendar days prior to the accident flight.

27 June: The airplane completed 2 flight legs from ICN to TPE and back to ICN. There were a total of 7 routine maintenance items accomplished, including a phased 9GA check. The routine checks included a weekly check and data uploading. There were no additional maintenance items generated during the two flight legs.

28 June: The airplane completed 4 flight legs:

Flight Leg 1: ICN to KIX

Flight Leg 2: KIX to ICN

Flight Leg 3: ICN to SFO

Flight Leg 4: SFO to ICN (arrived ICN on 29 June)

There was one maintenance log item which occurred during flight leg 4. The crew received a message “VHF datalink”. Maintenance resolved the issue by resetting the circuit breaker for the Left AIMS (Airplane Information Management System) cabinet per the Fault Isolation Manual.

29 June: The airplane completed two flight legs from ICN to LAX and then from LAX to ICN, arriving on 30 June. There were no maintenance items generated during these two legs. No scheduled maintenance work was noted.

30 June: There were no additional entries for this date

01 July: The airplane completed 4 flight legs:

Flight Leg 1: ICN to KIX

Flight Leg 2: KIX to ICN

Flight Leg 3: ICN to SFO

Flight Leg 4: SFO to ICN (arrived ICN on 2 July)

There were 4 maintenance entries in the log. One consisted of a wheel/tire change on the Main Landing Gear (worn tire); the other three were scheduled MPD related tasks including software update loads and inspect/cleaning of the area under the forward cargo compartment.

02 July: There were no additional entries for this date.

03 July: The airplane completed 2 flight legs from ICN to CDG and then from CDG to ICN.

There were 8 maintenance entries in the log. Three of these were MPD scheduled transit tasks, one for a malfunctioning flight deck hand microphone, one for the replacement of a monitor in the cabin, and a deferred item involving the discovery of the left wing flaperon inboard seal which was missing.

04 July. The airplane completed 2 flight legs from ICN to LAX and then from LAX back to ICN.

There were 2 maintenance items in the log; one for the F/O's hand microphone INOP and an MPD scheduled task.

05 July: There were no additional entries in the log.

06 July: The airplane completed 2 flight legs from ICN to KIX and then from KIX back to ICN. The final flight leg from ICN to SFO terminated with the accident in SFO.

There was one MPD (Clean and Inspect #1 and #2 magnetic chip detector) scheduled task completed in ICN prior to the flight to SFO.

The aircraft flight logs were also reviewed from the period of 1 January 2013 to the time of the final flight of the aircraft paying particular attention was given to ATA chapters for flight management systems; navigation systems; flight controls; and powerplant operation. No significant discrepancies were recorded during this review period.

In 2012, the accident airplane recorded three Auto Throttle Messages (22 April 2012, 12 July 2012 and 12 August 2012). The corrective action for all three cases was a testing of the system with no anomalies noted after the test.

See Attachment 6 for further information

10.0 Weight and Balance Summary

The Asiana Airlines Inc. B777 airplanes are weighed every 36 months. The last actual weight and balance on the accident airplane was accomplished on 1 July 2011 at Ameco Beijing. The figures for last weight and balance are shown below:

Basic Empty Weight:	309,943.47 pounds
Arm:	1234.91 inches*
Moment:	381439842.94 lb.-inches

*includes 2.40 inch correction factor for measured airplane angle while resting on the scale.

See Attachment 7 for further information

11.0 Major Repairs and Alterations

According to the maintenance records, there were three major repairs/alterations accomplished on the accident airplane. No discrepancies were noted.

Table 9 – Major Repairs and Alterations

Maintenance Engineering Order	Description	Date Accomplished
TLX 1-1563537566	L/H Wing Outboard Fixed L/E Upper Skin Crack Trim Out	15/Apr/2010
CB CB7-25-1643 CB CB7-25-1714	Cabin Upgrade	23/May/2011

12.0 Time Regulated Part

Time Regulated Part status for the airplane and the two installed powerplants were reviewed. The compliance status was satisfactory. There were no discrepancies.

13.0 Vendors

The Maintenance Records Group reviewed the Approved Vendor List provided by Asiana Airlines, Inc. All essential maintenance vendors were listed in the operator's Approved Maintenance Provider List. There were no discrepancies in the listing.

14.0 Method of Record Keeping

Asiana Airlines, Inc. Maintenance Policy and Procedures Manual is written in the Korean language, therefore the investigative team could not determine the company's procedures for maintenance record keeping. However, based on the documents and information the investigative team has received, it is consistent with an airline's required record keeping process.

15.0 Escape Slide/Raft Documentation

Asiana Airlines maintains the B777 escape slide/rafts in accordance with the Boeing Maintenance Planning Document requirements. The MPD requirements reflect those maintenance actions as specified by the slide/raft manufacturer, Air Cruisers, Inc. On wing and off wing maintenance was accomplished on the slide rafts. When required, the slide raft is routed to the Asiana Airlines slide shop (located at Gimpo airport) for maintenance, including overhaul.

The maintenance schedule for the slides is annotated in the table below. Review of records provided by Asiana Airlines indicates the slide rafts installed on the accident airplane were in compliance with the required MPD limits.

Table 10 – MPD Slide Task

MPD reference	TASK
25-210-00	Overhaul slide per Manufacturer's recommendation (see note for interval)
25-221-00	Inspect and Hydrostatic test Slide/Raft Inflation Cylinder (see note for interval)
25-230-00	Inflation cylinder pressure inspection (see note for interval)
25-240-00	On-aircraft deployment of one (1) slide per fleet (see note for interval).

Notes:

For 25-210-00: Air Cruisers specifies an overhaul interval of 42 months per Service Information Letter (SIL) 25-219 for slides that have been in service for less than 15 years. Slides in service for longer than 15 years have a recommended service interval of 1 year.

For 25-221-00: Air Cruisers specifies that this task be completed per the applicable DOT standard for the reservoir. Air Cruisers CMM 25-65-22 for the reservoir indicates that it was manufactured per DOT SP-11194 which states that the inspection/hydrostatic interval was 60 months for reservoirs retested after 01 July 2001 and 36 months for reservoirs retested prior to 01 July 2001. Asiana paperwork indicates that the accident airplane reservoirs are inspected and tested every 42 months.

For 25-230-00: The Boeing MPD specifies that this task be conducted every 1000 flight hours. Asiana's task card 7A-25-230-00-01 likewise calls for this task to be completed on a 1000 hour interval of a 2GA check with a repeat of a 2GA check.

For 25-240-00: The Boeing MPD specifies this task was to be done every 1125 days. Asiana's task card 7A-25-240-00-01 likewise calls for the task to be conducted every 1125 days.

The following information shows information on the slide and rafts installed on the accident airplane:

Table 11 – Slide and Raft Installation

Position	P/N	S/N	Date Installation	Date Manufacture	Date Last Overhaul	Location Last Overhaul
L1 DOOR	62771-123	1891	1/Dec/2010	30/Jun/2007	25/Nov/2010	Asiana Airlines
R1 DOOR	62771-124	2192	19/Jun/2011	31/May/2008	17/Jun/2011	Asiana Airlines
L2 DOOR	62772-215	0901	24/Mar/2012	28/Jun/2002	22/Mar/2012	Asiana Airlines
R2 DOOR	62772-216	0704	26/Feb/2012	30/Nov/2000	24/Feb/2012	Asiana Airlines
L3 DOOR	62773-319	0867	20/May/2011	31/Mar/2002	20/May/2011	Asiana Airlines
R3 DOOR	62773-320	0860	6/Jul/2011	28/Feb/2002	4/Jul/2011	Asiana Airlines
L4 DOOR	62774-415	0957	20/Aug/2011	28/Feb/2002	4/Aug/2011	Asiana Airlines
R4 DOOR	62774-424	1281	17/Jan/2011	30/Apr/2007	17/Dec/2010	Asiana Airlines

The FAA has published one Airworthiness Directive, AD 2013-05-10, against the slide rafts. The AD was issued to detect and correct possible corrosion to the slide release mechanism, which could impair deployment of the slide raft. Compliance records provided by Asiana Airlines reflect the AD was applicable to all 8 door positions on the event aircraft. The required AD action was accomplished on 6 of the 8 door positions, with the exception of doors 1L and 4R. However, the AD compliance status was current, as the compliance “accomplish by” date had not yet been reached for the slides installed in these positions.

The Maintenance Group received the Survival Factors Field Notes regarding the accident airplane escape slide teardown at Air Cruisers during the week of 29 July 2013. Three issues of note specific to the accident airplane slides were documented.

- The discharge cylinder safety pin common to the Door 4R slide was found installed during the post accident examination.

The Door 4R escape slide was overhauled by Asiana at the Gimpo maintenance facility. The indicated Work Order has a close date of 17 December 2010. It was installed on the accident airplane on 17 January 2011. Specific to the installation on the airplane was a step in the procedure to remove and stow the cylinder safety pin in a pouch common to the slide pack. This procedure was stamped off as complete by the mechanic and was not stamped off by an inspector. According to Asiana maintenance personnel, an inspector signoff was not required.

According to the maintenance records (Work Order 4001682604) for the accident airplane, maintenance installed (2 December 2012) and removed (8 December 2012) the discharge cylinder safety pin upon completion of a scheduled GB-Check. There exists no additional maintenance non-routine activity concerning the affected door.

- Six of the sixteen pin shield attach fasteners were found to be missing from the Door 1R slide. This shield was part of the pack release mechanism from the packboard.

The Door 1R escape slide was modified per Air Cruisers Service Bulletin 107-25-30 by Asiana at the Gimpo maintenance facility. The indicated Work Order has a closed date of 17 June 2011. The work order indicates that all 16 spring pin shield fasteners were removed and replaced utilizing new fasteners. There are no specified torque installation values per the Air Cruisers CMM or the Service Bulletin and the work was stamped off by the mechanic.

- The activation lanyard for the Door 3L slide lighting system was present but not rigged to the battery.

During the post-accident component teardown examination of the door slide 3L (P/N 62773-319; S/N 0867), it was observed the slide raft lighting system activation lanyard was not attached to the battery, and the lanyard as attached, was determined to be 19" in length. It was discovered an additional coiled lanyard was engaged in the battery activation clip, and the battery. The date of manufacture of the lighting system battery was February 2010.

The date of manufacture of the door slide was recorded as March 2002. The slide was received by Asiana Airlines upon delivery of aircraft HL7700 on 26 May 2002 new from Boeing. The slide was removed for overhaul in 2003, and re-installed on aircraft HL7596. The next removal was recorded as occurring in 2005, and the slide re-installed on aircraft HL7500 on 30 December 2006. The next removal was recorded as 6 February 2008, and re-installed on aircraft HL7732, on 6 April 2008. The slide was removed on 13 May 2011, overhauled, and reinstalled on aircraft HL7742 on 20 May 2012, where it remained until the time of the accident.

According to Air Cruisers, new batteries come equipped with a device which prevents activation of the battery. This consists of either a pin or a barrel device and is attached to a length of coiled shipping lanyard material. During slide folding operations, the intent is to remove the shipping device and lanyard and install the correct lanyard/activation device as attached to the slide inflatable.

Overhaul documents available for review did not detail maintenance practices relative to the attached lighting lanyards on the slide, and attachment to the lighting connector. There is a separate slide folding document (Air Cruisers

document P-12053 for the door #3 slide), however, which does have details of when and how the lightning lanyard is connected. However, there is no mention of the installed 'shipping lanyard' associated with the installation of a new battery.

When new slide assemblies are received by Asiana Airlines, a receiving inspection is routinely accomplished. The inspection entails a review of the slide certification documents, and physical examination of the shipping container for damage. The slide is not unfolded at this time for further examination, but rather is placed on a shelf until required for installation on an aircraft.

No aircraft maintenance manual reference exists which provides information for maintenance activity concerning the door slide raft lighting system.

See Attachment 8 for further information

16.0 Asiana Component Shop Audit

The Investigative team requested the last two Asiana Quality Assurance Audits of the component shops, including the Escape Slide Shop. The investigative team received the audit but the audit was in Korean. According to Asiana representatives Quality Audits were conducted on 19-21 March 2012 and 18-19 April 2013. The audits are conducted yearly. Several findings were noted in the other component shops (avionics and accessory shops) but none for the slide shop.

17.0 Ministry of Lands, Infrastructure and Transport (MOLIT)

Regulatory oversight is accomplished by an assigned Principal Maintenance Inspector (PMI) and a Principal Operations Inspector (POI). There are assigned assistants to each of these disciplines. The Maintenance Group review focused on PMI activities for the 2013 calendar year. The PMI is responsible for the regulatory oversight of Asiana Airlines' 81 aircraft, in addition to oversight of Air Pusans' 10 aircraft. The currently assigned PMI indicated daily, monthly and annual inspections are scheduled and accomplished. Risk Analysis is the basis for defining the areas of the operation requiring surveillance. Where weaknesses are determined to exist, heightened surveillance activity is requested and scheduled. Annually, a risk assessment of the maintenance operation is accomplished, and resulting from that, new audit plans were made.

In discussions with the PMI, he indicated he recommends approval for any Operations Specification changes for the air carrier. He does not have the approval authority for the maintenance paragraphs. Operations Specification change authority resides at a higher level within the MOLIT. At the time of the accident, according to the PMI, there were no open regulatory violations or investigations of Asiana Airlines by the Korean MOLIT.

Records of PMI activities that were provided to the team reflected thirty-two (32) accomplished safety audits within Asiana Airlines maintenance since 1 January 2013 to 6 July 2013. From the records reviewed, five findings (see attachment) were identified. These were all in the caliber of “recommendations” to Asiana Airlines, and none were specific to the accident aircraft. The PMI also accomplished informal daily observations of line and base maintenance operations. Any findings were documented and follow-up action taken, based on the severity of the findings.

Asiana Airlines has a voluntary disclosure program for maintenance and operations. This program allows employees to cite potential maintenance issues for a given airplane or for the maintenance program in general without fear of consequences. The Asiana Airlines PMI indicated the program was not widely utilized within the maintenance community. The PMI additionally indicated the Asiana Airlines maintenance culture is compliant their procedures and MOLIT’s regulations.

See Attachment 9 for further information

Pocholo Cruz
Aerospace Engineer

Attachments:

- Attachment 1 – Operating Certificate
- Attachment 2 – Maintenance Checks
- Attachment 3 – Minimum Equipment Lists
- Attachment 4 – Supplemental Type Certificates
- Attachment 5 – Airworthiness Directives and Service Bulletin
- Attachment 6 – HL 7742 Flight Logs
- Attachment 7 – Weight and Balance
- Attachment 8 – Slide Data
- Attachment 9 – Principal Maintenance Inspector Work Program